Recent Progress in Stochastic Cloud Clearing and Neural Network Atmospheric Profile Estimation

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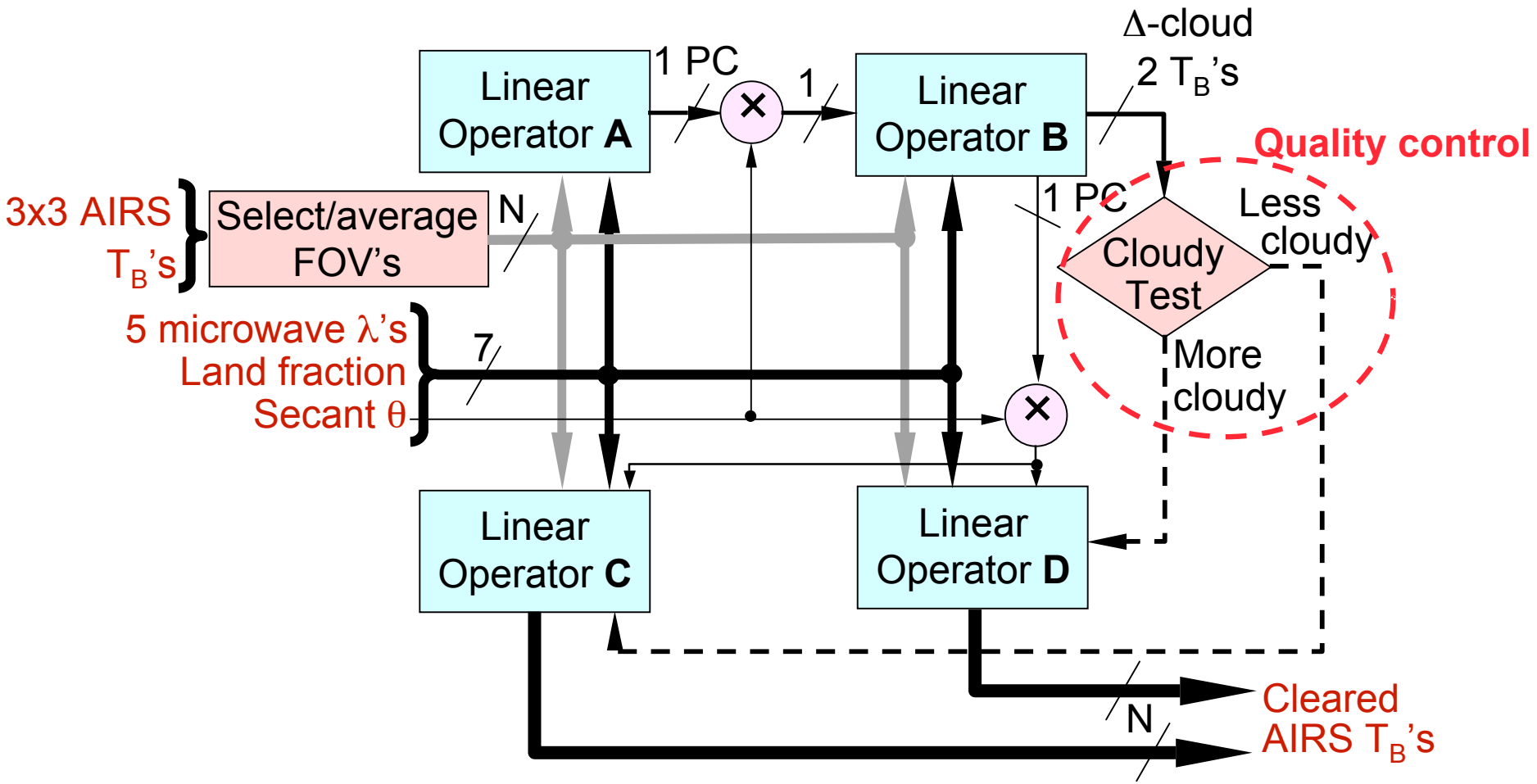
Recent Updates to SCC+NN Algorithm

- Cloud-cleared radiance estimates are produced for ALL 2378 AIRS channels
- Retrieval is now truly global:
  - Retrievals for ALL latitudes are now supported
  - Ocean and Land cases are supported
  - Day and night
- Quality control has been implemented
- RMS retrieval accuracies have been improved across all QC stratifications
- AIRS-only option implemented

Outline

- Brief algorithm overview
  - Stochastic cloud clearing (SCC)
  - PPC compression
  - Multilayer feedforward neural networks (NN)
- SCC performance with QC
- SCC+NN performance comparisons with Version 4 algorithm
- AIRS-only performance
- Future Work / Summary

Block Diagram of SCC Algorithm



N = 2378 channels

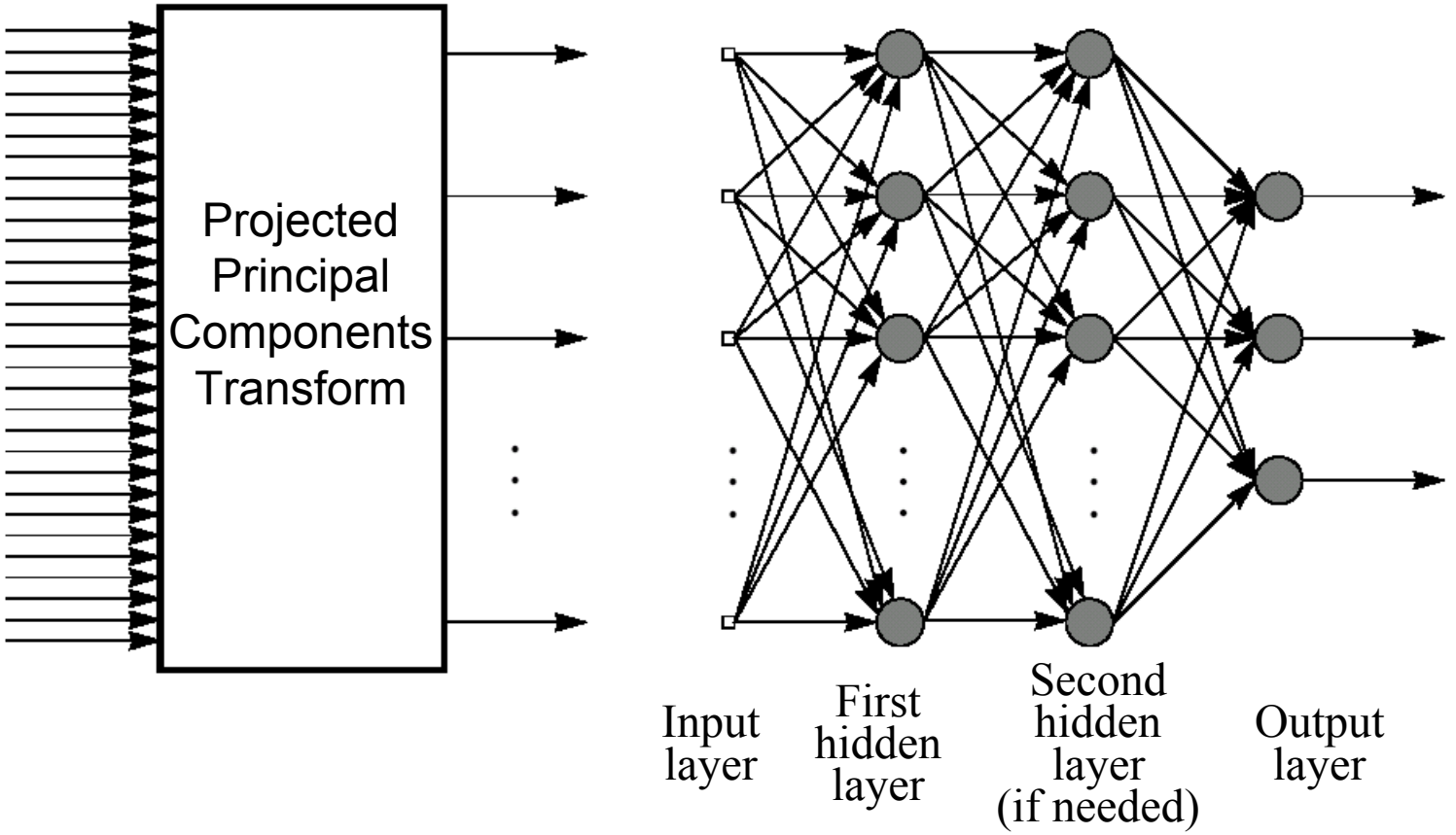
Cho and Staelin, Aug. 2006

SCC+NN Quality Control

- Simple, linear function of estimated radiance correction for a set of channels
- Framework allows for altitude-dependent quality flags
- Yield versus accuracy trades can be easily performed
  - For the results I'll show today, the SCC+NN QC has been adjusted to roughly match the performance of the tightest Level 2 V4 test (Qual_Surf).
  - SCC+NN yield exceeds V4 algorithm by a factor of about 4

Combination of Compression and Neural Network

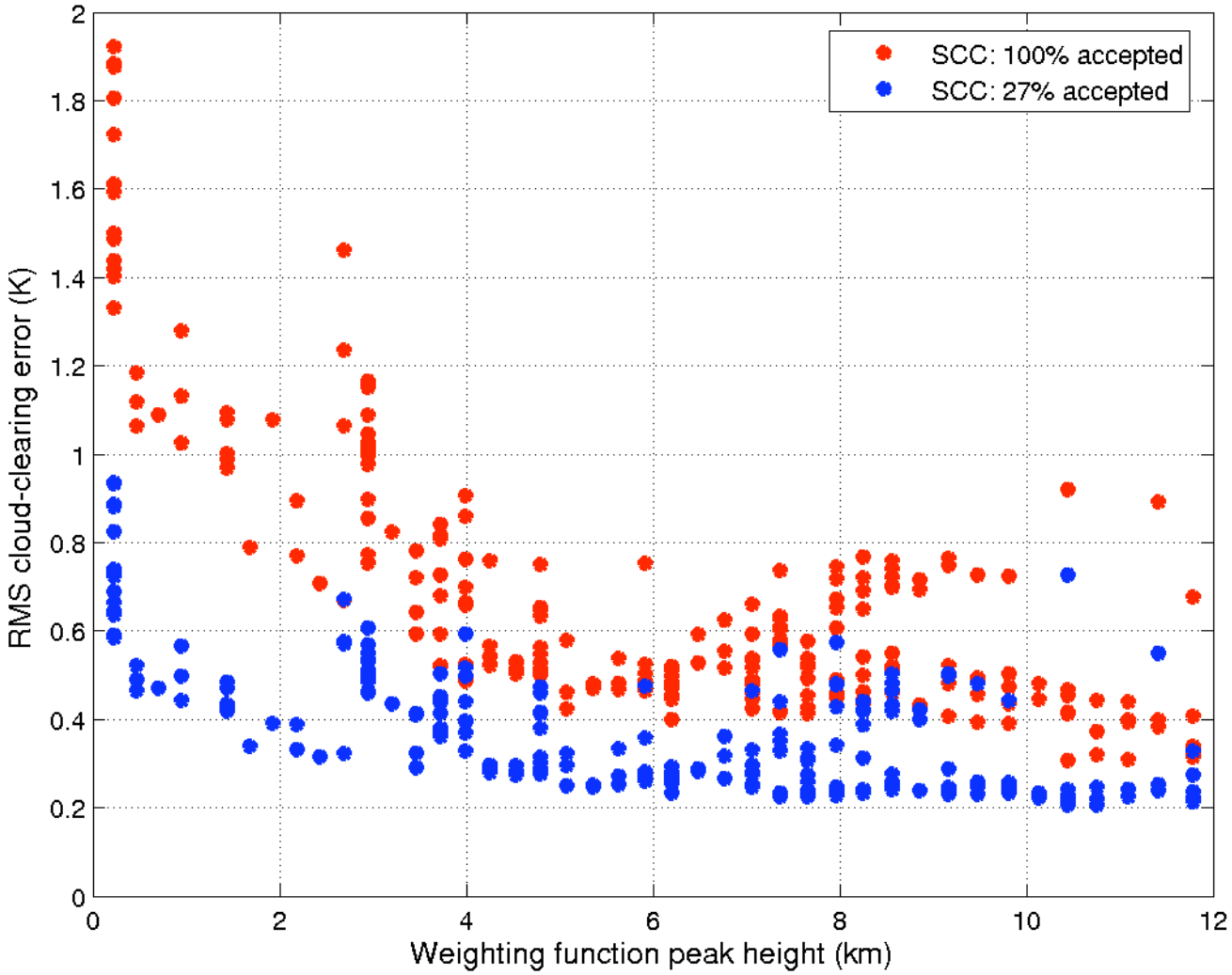
$\tilde{R}$ $\tilde{P}$ $\hat{T}$



Retrieval Performance Validation with AIRS/AMSU/ECMWF Match-up Data

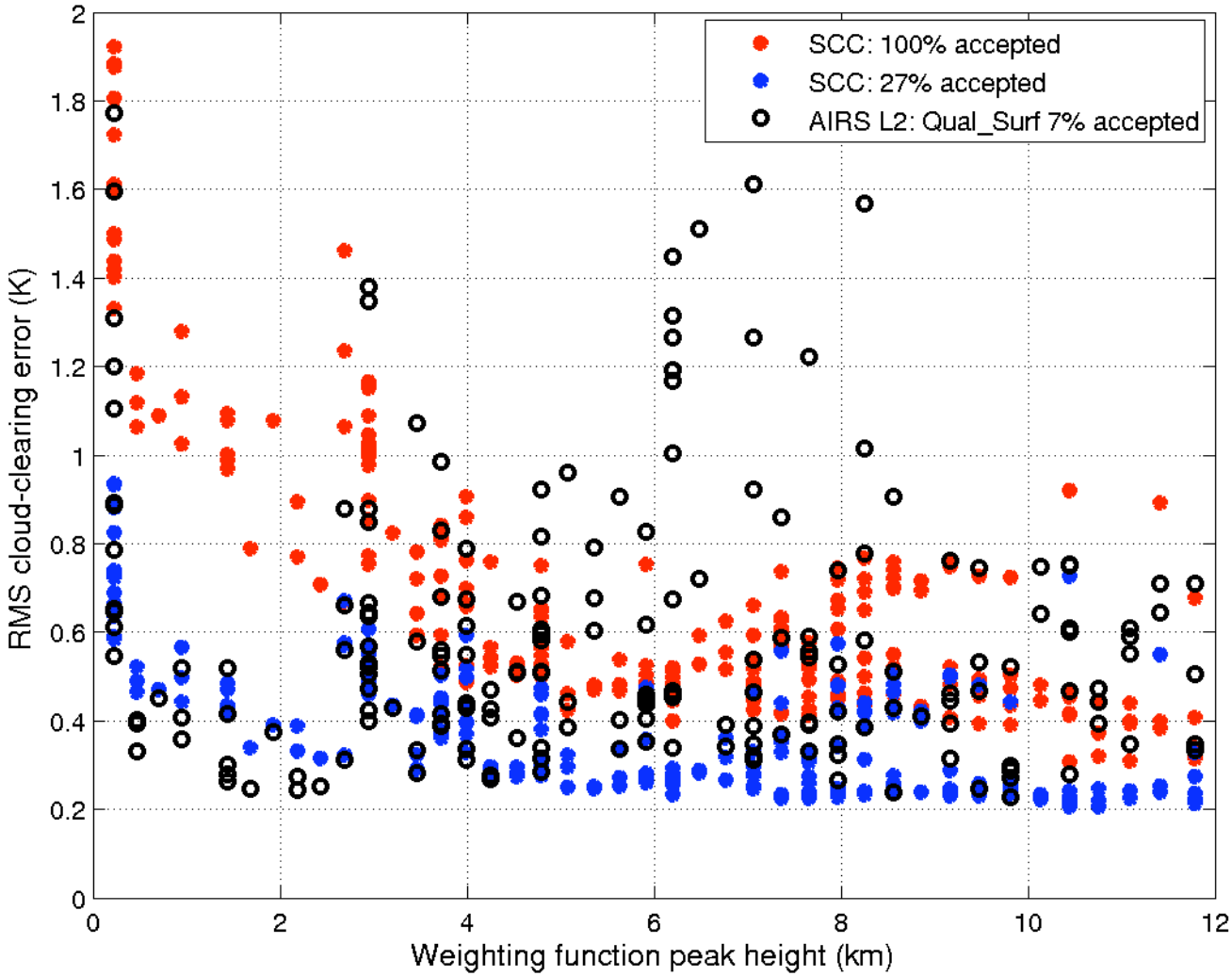
- >500,000 co-located AIRS/AMSU/ECMWF observations from seven days:
  - 2002: Sep 6
  - 2003: Jan 25, Jun 8, Aug 21, Sep 3, Oct 12, Dec 5
- ~100,000 profiles set aside for validation set
- All latitudes

Stochastic Cloud Clearing
NEW: Quality Control



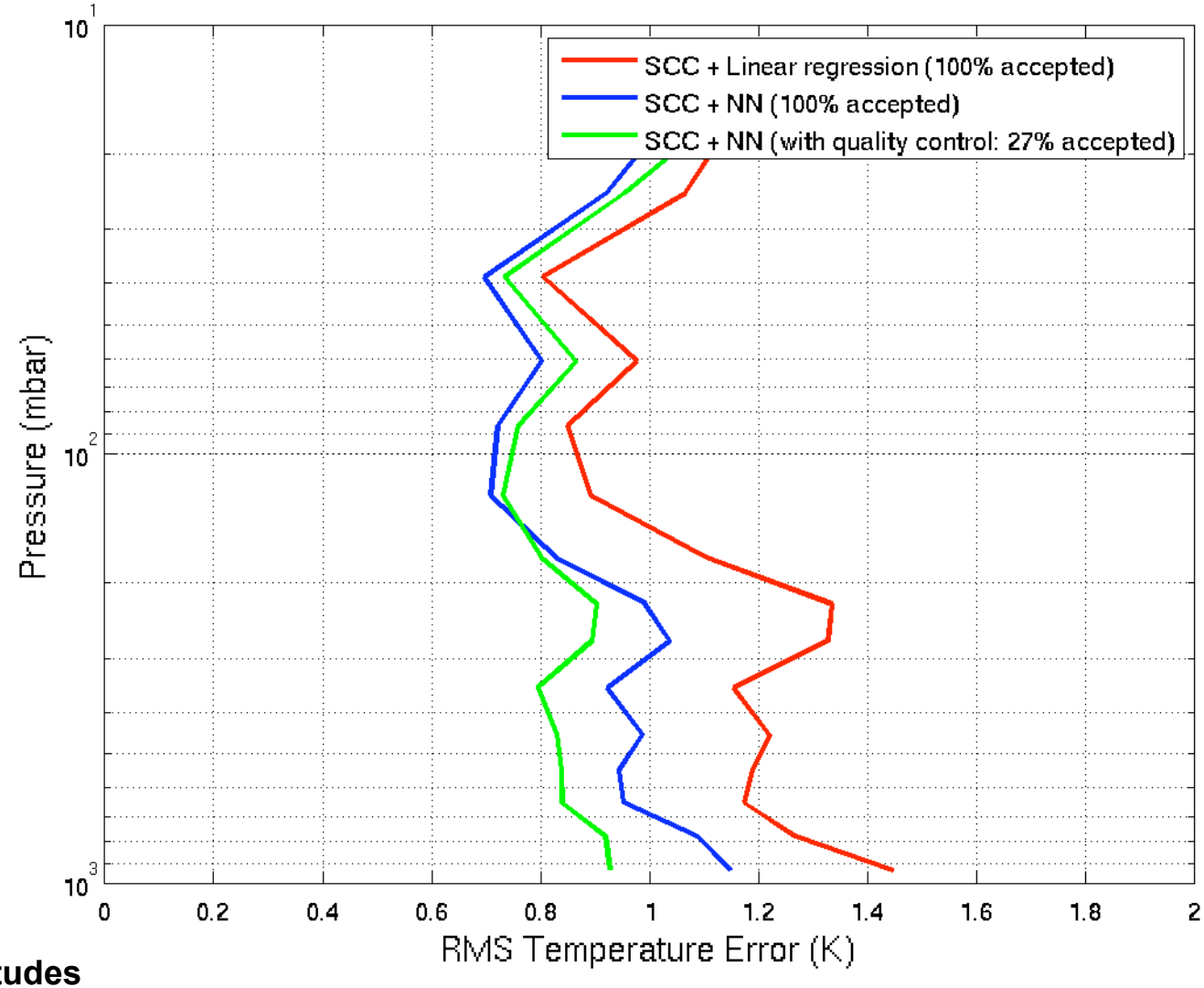
Ocean, All latitudes

Stochastic Cloud Clearing
NEW: Quality Control



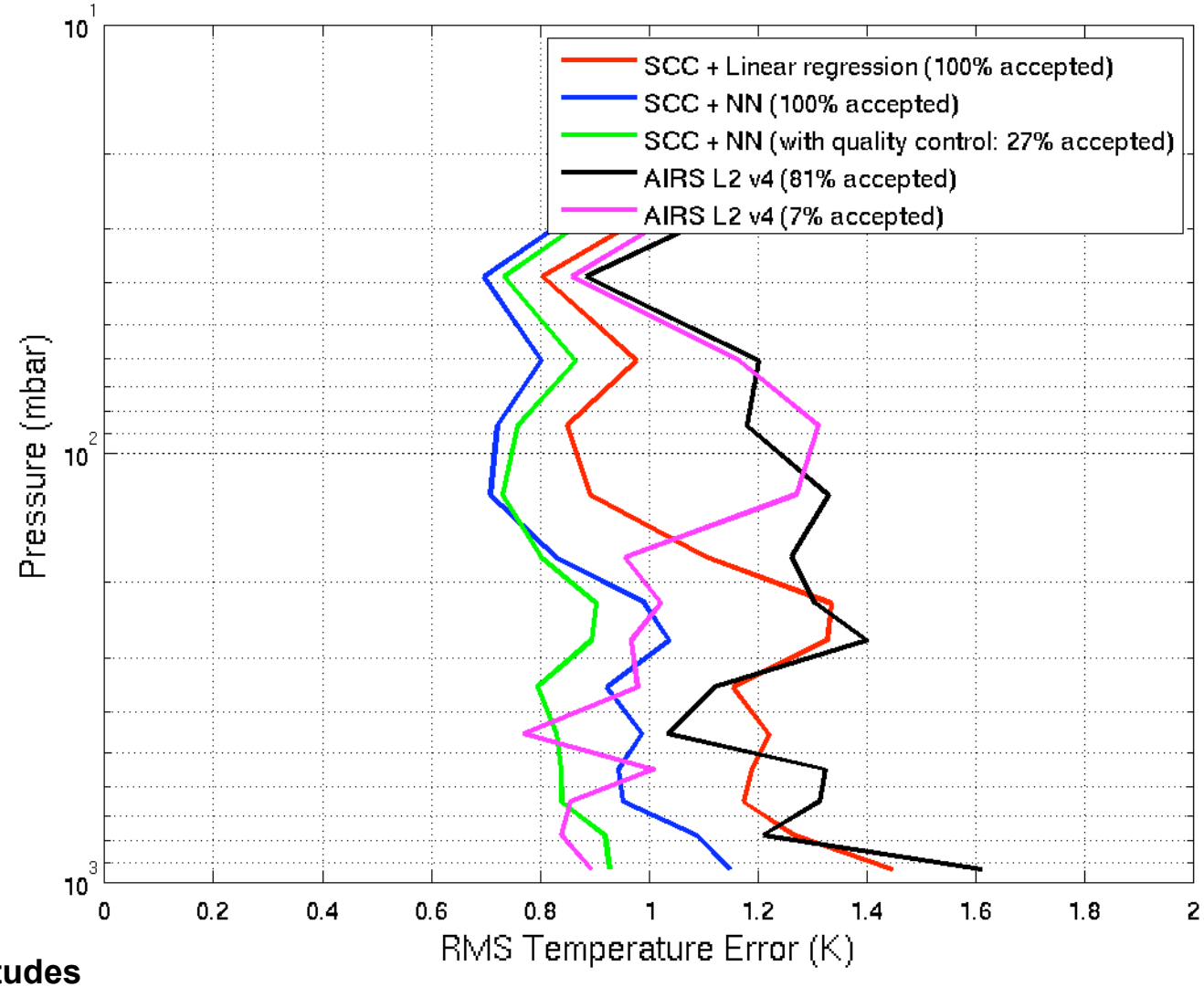
Ocean, All latitudes

SCC + NN T(h) Retrieval
NEW: Quality Control



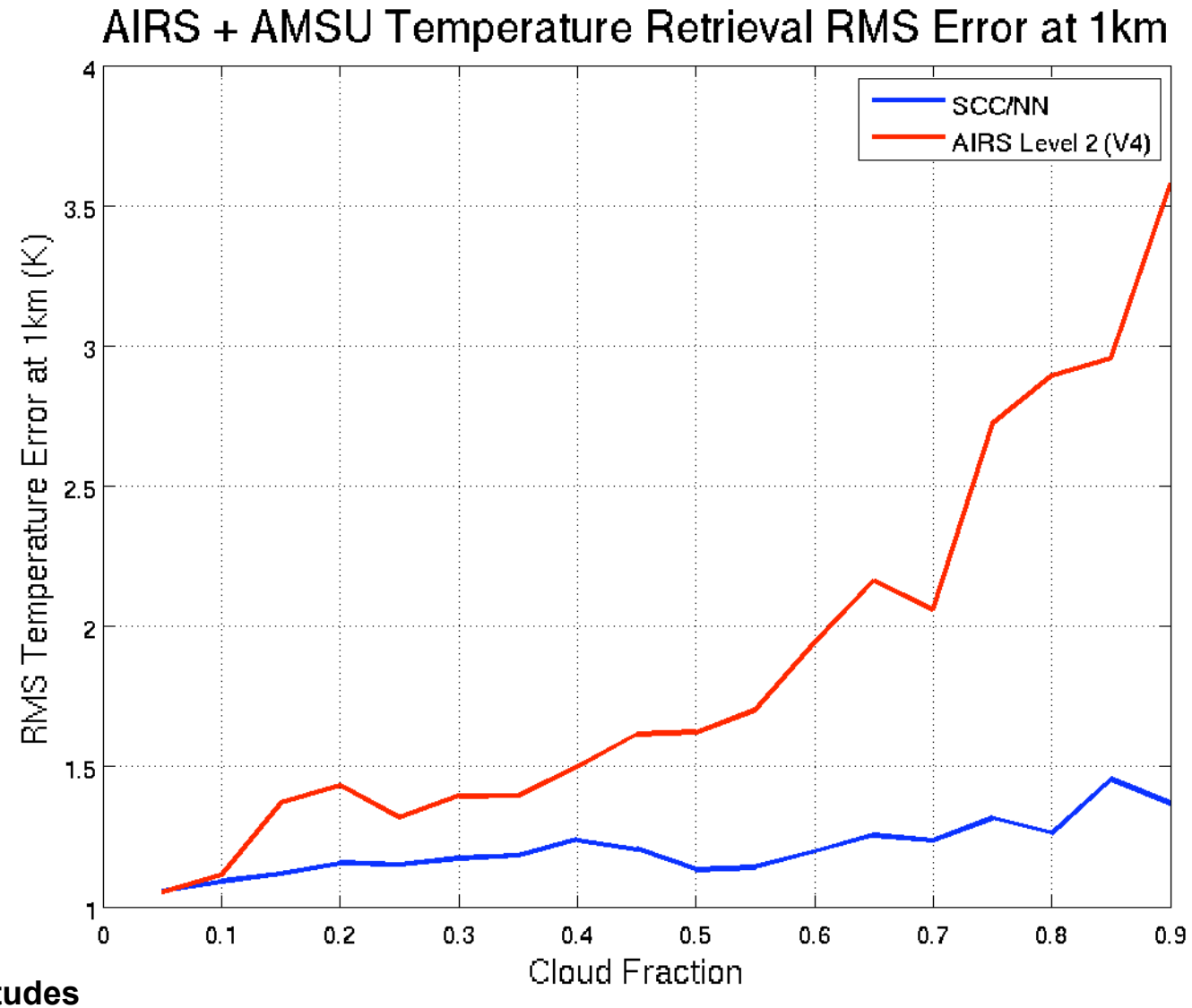
Ocean, All latitudes

SCC + NN T(h) Retrieval
NEW: Quality Control



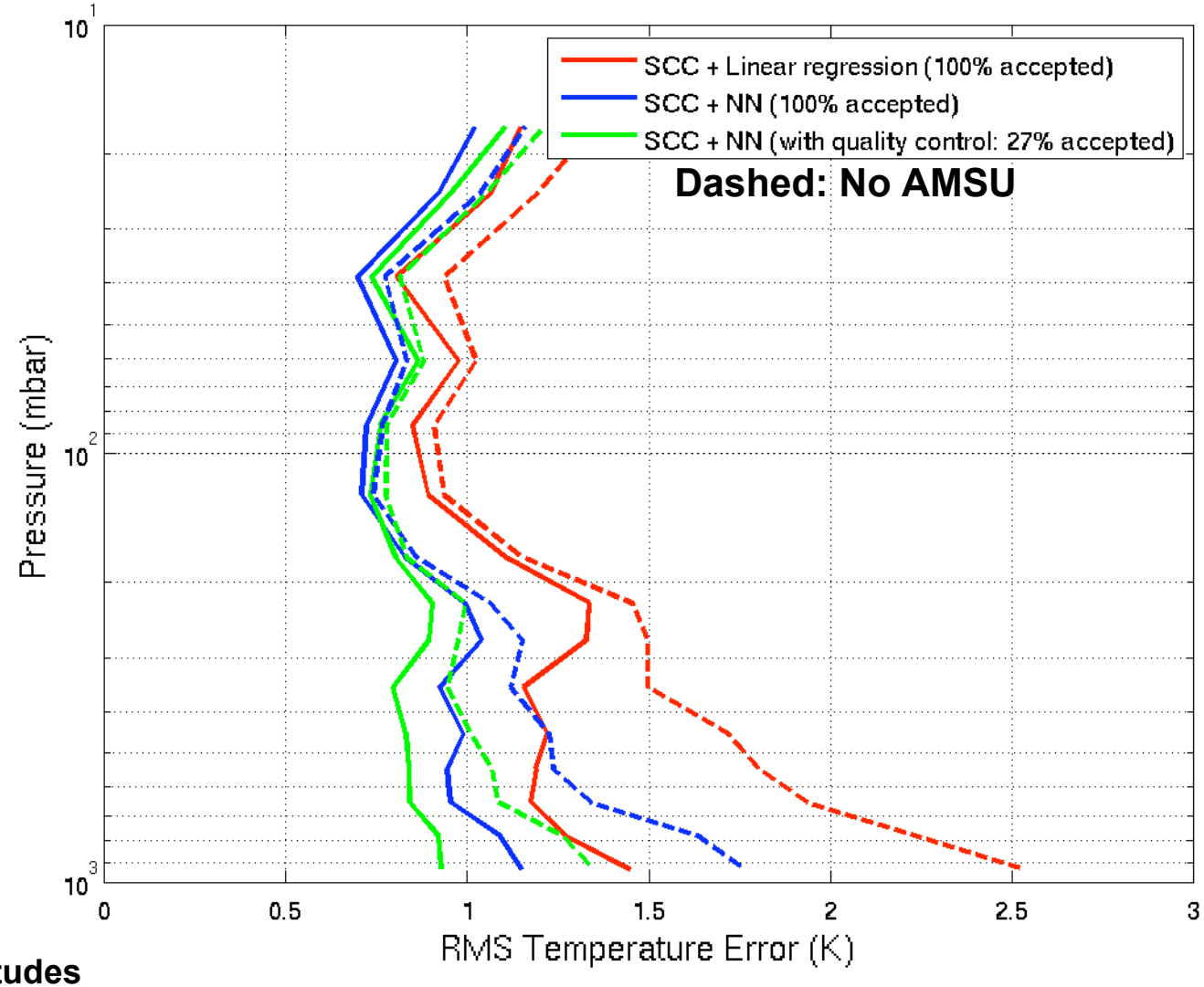
Ocean, All latitudes

T(h) RMS Error Versus Cloud Fraction SCC+NN v. V4 (common ensemble)



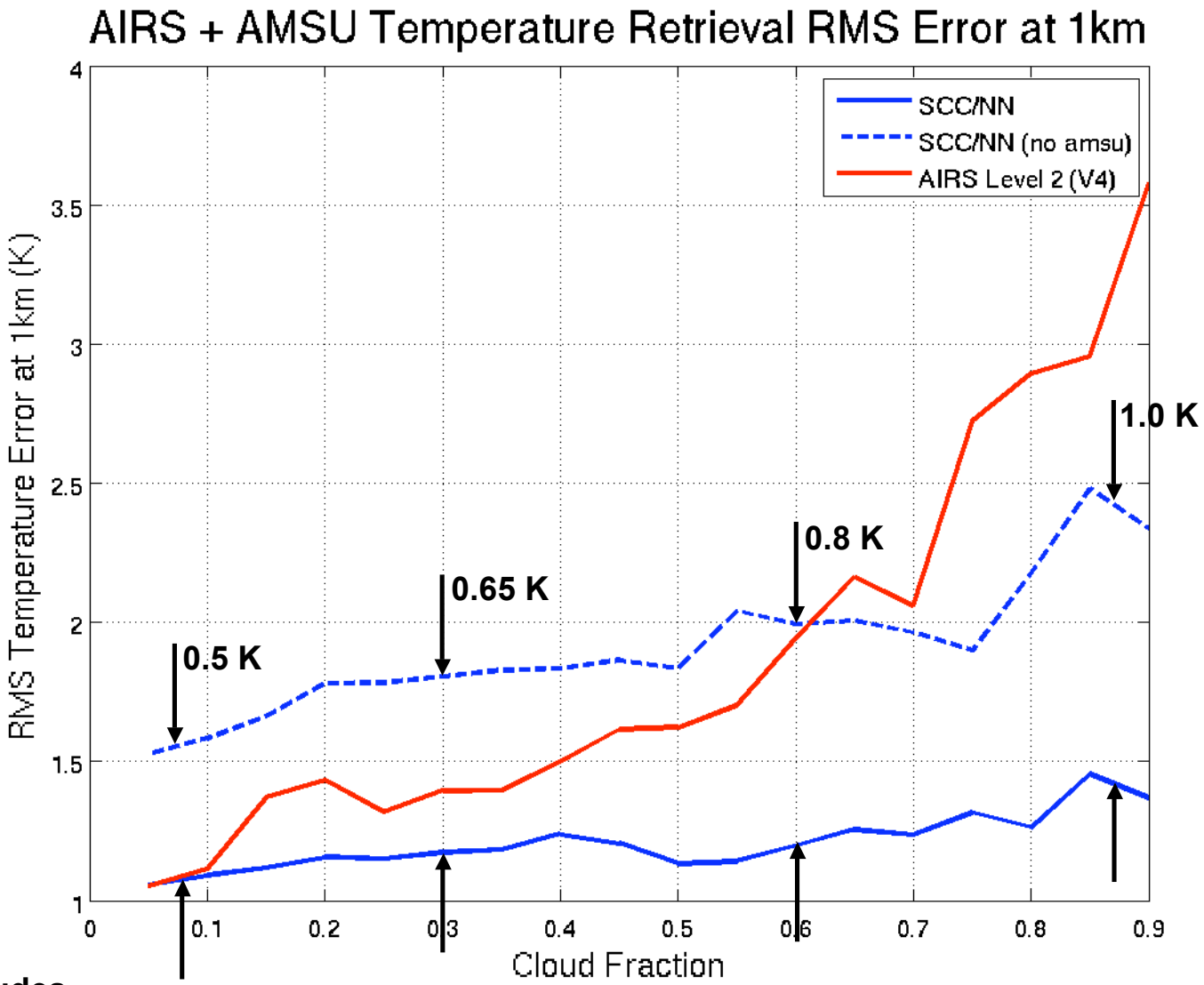
Ocean, All latitudes

SCC + NN T(h) Retrieval With and Without AMSU



Ocean, All latitudes

T(h) RMS Error Versus Cloud Fraction With and Without AMSU



Ocean, All latitudes

Future Work

- Additional and more extensive performance assessments
  - Additional match-ups with RAOB data
  - Comparisons with latest AIRS Level2 products (v5)
- Algorithm optimizations
  - Improved handling of land / surface emissivity
  - Retrieval extensions to include ozone and trace gases
- Adaptation of algorithm for CrIMSS
  - Very helpful for system performance evaluations
  - Useful tool for cal/val

Summary

- Recent SCC+NN enhancements:
  - Global (all latitudes, land/ocean, day/night)
  - All AIRS channels are cloud-cleared
  - Quality control
  - Improved accuracies

- SCC+NN and V4 comparisons indicate:
  - V4 and SCC+NN both perform very well in regions of light clouds (cloud fractions below 0.4).
  - There appears to be substantial room for improvement in the V4 algorithm in regions of heavy clouds.

- AMSU adds significant information content, both in regions of light clouds and, especially, in regions of heavy clouds